Pallid Bat (*Antrozous pallidus*)

Photo courtesy of Scott Trageser.

Legal Status

State: Species of Special Concern
Federal: Bureau of Land Management Sensitive
Critical Habitat: N/A
Recovery Planning: N/A
Notes: None

Taxonomy

The pallid bat (*Antrozous pallidus*) is the only species in the genus *Antrozous* of the family Vespertilionidae (Hermanson and O'Shea 1983; Hoofer et al. 2003) (*Antrozous* formerly included *A. dubiaquercus*, but this Central American species is now assigned to the genus *Bauerus* [Hermanson and O'Shea 1983]). A study of phylogenetic relationships of plecotine bats using mitochrondrial ribosomal sequences supported the placement of pallid bat as a single-species genus in the family Vespertilionidae (Hoofer et al. 2003). There are seven recognized subspecies of pallid bat (Wilson and Reeder 2005), of which *A. p. pallidus* is likely the subspecies present in the Desert Renewable Energy Conservation Plan (DRECP) project Plan Area, although *A. p. pacificus* may also occur in the western portion of the Plan Area (Hall 1981). The status of pallid bat as California Species of Special Concern is for the full species *A. pallidus*, so a subspecific assignment is not relevant to the conservation of this species in the Plan Area. No other available information indicates other important taxonomic considerations. The species' physical characteristics are described in detail in Hermanson and O'Shea (1983).

Distribution

General

The pallid bat is widespread throughout the western United States; southern British Columbia, Canada; and mainland and Baja California, Mexico (Hermanson and O'Shea 1983; Hall 1981). Within the United States, it ranges east into southern Nebraska, western Oklahoma, and western Texas (Figure SP-M07). The pallid bat is locally common in the Great Basin, Mojave, and Sonoran deserts (especially the Sonoran life zone) and grasslands throughout the western United States, and it also occurs in shrublands, woodlands, and forests at elevations up to 2,440 meters (8,000 feet) (Hermanson and O'Shea 1983; Hall 1981). The pallid bat occurs throughout California, except at the highest elevations of the Sierra Nevada range. Although this species prefers rocky outcrops, cliffs, and crevices with access to open habitats for foraging, it has been observed far from such areas (Hermanson and O'Shea 1983).

Distribution and Occurrences within the Plan Area

Historical

The DRECP database for pallid bat, composed of Bureau of Land Management (BLM) and California Natural Diversity Database (CNDDB) (CDFW 2013) records, and observations by Brown (CDFW 2013; Dudek 2013), includes 20 historical records (i.e., pre-1990) for the Plan Area, dating from 1911 to 1981, and two with an unknown observation date. An additional 11 records are from areas within 5 miles of the Plan Area boundary. The historical occurrences in the Plan Area include the southern Owens Valley–eastern Sierra Nevada–Inyo Mountains area, the Mesquite Mountains in eastern San Bernardino County, the Twentynine Palms area, the lower Colorado River, and the Salton Sea area.

See Figure SP-M07 for historical and recent occurrences of pallid bat in the Plan Area.

Recent

There are 40 recent (i.e., since 1990) records in the Plan Area and 10 additional records within the 5-mile buffer area around the Plan Area (CDFW 2013; Dudek 2013). The geographic areas of recent occurrences are similar to the historical occurrences, with small clusters of observation in the Owens Valley–eastern Sierra Nevada area, Providence Mountains, Kingston Range, Avawatz Mountains, Cady Mountains, Twentynine Palms area, Little San Bernardino Mountains, Hexie Mountains, the Lower Colorado River, Chocolate Mountains, and the Peninsular Range in east San Diego County.

As with the historical data, the specificity of these recent occurrence data is variable, with some records identifying roosts and others only including general location information for observations. This dataset, therefore, should be viewed as reflecting the recent documented distribution of the species in the Plan Area and should not be used as detailed data for specific roost sites.

Natural History

Habitat Requirements

Pallid bat day roosting habitat typically includes rocky outcrops, cliffs, and spacious crevices with access to open habitats for foraging (Hermanson and O'Shea 1983; Vaughan and O’Shea 1976). Pallid bats may also roost in caves, mines, bridges, barns, porches, and bat boxes, and even on the ground under burlap sacks, stone piles, rags, baseboards, and rocks (Beck and Rudd 1960; Rambaldini 2006). Radiotelemetry data has also shown that in the desert pallid bats will roost in holes on the ground and in rock crevices on creosote bush flats, not just in mountain ranges (Brown, pers. comm. 2012). Up to the late 1940s, they were common in buildings at low elevations of the South Coast Ecoregion (Miner and Stokes 2005). For example, in the Newhall area of Southern California, they recently were observed using buildings for both day and night roosts (Johnson 2006). In Northern California, they were observed using buildings and large-diameter, tall, live trees and snags in mature forest stands for both day and night roosting (Baker et al. 2008). In Baker et al. (2008), live trees and snags used for roosting were consistently tall in height, large in diameter, and located in mature stands in micro-sites with low percentages of overstory and mid-story cover. Day roosts generally are warm, have obstructed entrances and exits, and are high enough to avoid terrestrial predators (Rambaldini 2006). A study of night roosts, including rock overhangs, bridges, and buildings, in Oregon found that they were protected from rain and allowed free flight space for bats in and out of the roost (Lewis 1994).

Although pallid bats may use a variety of roosting habitats, they are also selective of roost sites with microenvironments that minimize energy expenditure through adaptive hypothermia and maintain low metabolic rates (Vaughan and O'Shea 1976). In spring and fall at roost sites in Central Arizona, they used vertical crevices that passively warmed during the afternoon prior to emergence, and in the summer, they used deep horizontal crevices that acted as heat sinks and kept ambient temperatures low (Vaughan and O'Shea 1976). A roost temperature of about 30 degrees Celsius (86 degrees Fahrenheit) is considered about optimal for maintaining low metabolic rates (Trune and Slobodchikof 1976; Vaughan and O'Shea 1976). In desert regions, roost sites are often near water, although they have been observed in areas without apparent water sources (Hermanson and O'Shea 1983).

Pallid bat day roosts consisting of single- or mixed-sex colonies usually are established in crevices or man-made structures. Day roosts usually have at least 20 individuals and sometimes more than 200 individuals (Hermanson and O'Shea 1983).

Foraging habitats for pallid bats are varied and include grasslands, oak savannah woodlands, open pine forests, talus slopes, and agricultural areas (Rambaldini 2006). In a study of bat use of riparian habitats in southern Nevada, including riparian marsh, mesquite bosque, riparian woodland, and riparian shrubland, Williams et al. (2006) recorded about 88% of pallid bat occurrences in riparian woodland. Although most foraging probably occurs in close proximity to night roosts, movements greater the 2 kilometers (1.2 miles) from roosting sites in forest habitats are common (Baker et al. 2008), and movements up to 30 kilometers (18.6 miles) have been recorded (Hermanson and O'Shea 1983). See discussion in Spatial Behavior for more information.

Table 1 summarizes the likely habitat associations for pallid bat in the Plan Area.

Table 1. Habitat Associations for Pallid Bat

Land Cover Type	Land Cover Use	Habitat Designation	Habitat Parameters	Supporting Information
Rocky, Barren, and Unvegetated Community	Day and night roosts	Day and night roosting	>50% rocky slopes within 6.2 miles of water source	Hermanson and O'Shea 1983
All natural land covers (i.e., except developed and disturbed)	Foraging	Primary foraging	Natural land covers within 3.1 miles of day roosting habitat	Baker et al. 2008; Bell 1982; Rambaldini 2006
All natural land covers (i.e., except developed and disturbed)	Foraging	Secondary foraging	Natural land Covers 3.1 to 6.2 miles of day roosting habitat	Baker et al. 2008; Bell 1982; Rambaldini 2006

Notes: Water sources include major rivers, reservoirs, lakes, ponds, seeps and springs, and perennial streams. Pallid bats are expected to forage in virtually all relatively open, natural land covers in the Plan Area where suitable prey are present.

Foraging Requirements

Pallid bats forage about 0.5 to 2.5 meters [1.6 to 8.2 feet] above the ground surface, and their foraging behavior is directed toward prey that are close to the ground, on the ground, or perched on exposed vegetation (O'Shea and Vaughan 1977). They may forage both aerially and by gleaning from plants, and they have also been observed to take prey by crawling along the ground. Their diet generally has been described to include scorpions, ground crickets, solpugids, darkling ground beetles, carrion beetles, short-horned grasshoppers, cicadas, praying mantids, long-horned beetles, and sphingid moths (Hermanson and O'Shea 1983). While pallid bats are primarily insectivores, they have also been observed to eat lizards and smaller bats in captivity (Hermanson and O'Shea 1983) and likely take a variety of small vertebrates in the wild. Their specific diets vary geographically and may reflect genotypic or phenotypic selection (Johnston and Fenton 2001). Pallid bats generally take large prey (up to 6.0 centimeters [2.4 inches] total body length) (O'Shea and Vaughan 1977). In both a coastal area (Marin County) and a desert area (Caliente Mine in Death Valley) in California, pallid bats foraged for Orthoptera (grasshoppers, crickets) and Coleoptera (beetles), and smaller percentages of Solpugida (sun scorpions), Lepidoptera (moths), and Diptera (flies). At Caliente Mine, Coleoptera made up about 55% of their diet by volume, but diet changed over time, reflecting the availability of prey. Individuals in the local population tended to have the same diet at any given time (Johnston and Fenton 2001). In contrast, at the Marin County site, diets were varied, but the variation was related to individual differences (i.e., there was no "average" diet for the group such as that of the Caliente site), and these differences may have reflected learning that reduces searching and handling time (Johnston and Fenton 2001).

Reproduction

Pallid bats breed in October through December, and possibly through February (Hermanson and O'Shea 1983) (Table 2). Females store sperm and ovulation occurs during the following spring. Gestation is approximately 9 weeks, and birth in the southwestern United States typically occurs from May through June (Hermanson and O'Shea 1983). Litter size is typically 2 young (approximately 80% of litters (Bassett 1984)), and occasionally 3; yearling females may breed but litter size is 1 (Davis 1969; Hermanson and O'Shea 1983). The young are born relatively undeveloped, but they mature rapidly and engage in their first flight at 33 to 36 days (Davis 1969). They achieve full adult flight capability by about 49 days of age and full adult weight by 56 days of age (Hermanson and O'Shea 1983). Yearling males are not sexually active their first autumn and probably not their first year (Davis 1969). Mature males and females have the same body dimensions (e.g., weight, forearm length, wing area); they do not exhibit sexual dimorphism (Davis 1969).

Pallid bats have lived up to 9 years in captivity (Hermanson and O'Shea 1983).

Table 2. Key Seasonal Periods for Pallid Bat

	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Breeding	?	?								x	x	x
Birth/ Development					x	x	x	x				
Winter Torpor	x	x	x	x								x

Sources: Bassett 1984; Davis 1969; Hermanson and O'Shea 1983.

Spatial Behavior

Pallid bats in central Arizona exhibited a bimodal foraging activity pattern, with two foraging bouts separated by a period of night roosting, with the timing and duration of these activities seasonally variable (O'Shea and Vaughan 1977). During the summer months, time away from the roost varies between approximately 45% to 58% of the night. In September and October, time away from the roost varies between 25% to 27% of the night. (O'Shea and Vaughan 1977) Pallid bats may be active outside the roost any time of year, but their activity during the winter may be erratic, which probably is associated with cold periods when they are in torpor (Table 2). They have been mist-netted at temperatures as low as 2 degrees Centigrade (35.6 degrees Fahrenheit) in southern Nevada (O'Farrell et al. 1967). In contrast to O'Shea and Vaughan (1977), O'Farrell et al. (1967) did not detect a bimodal activity period in southern Nevada during the fall and winter; all captures were 1.5 to 5 hours after dusk. This information indicates that nightly foraging activity by pallid bats is seasonally variable.

During July through August, pallid bats in central Arizona showed little fidelity to specific roosting sites, but during the cooler months they showed greater fidelity to certain roosting sites (O'Shea and Vaughan 1977), which may reflect more specific roost requirements during the colder months to maintain thermoregulation (also see Habitat Requirements regarding day roost characteristics).

The distances that pallid bats travel during foraging bouts may be limited by the availability of night roosts because they frequently bring large prey to these sites where it is then eaten (O'Shea and Vaughan 1977). Bell (1982), for example, observed pallid bats foraging within 3 kilometers (1.9 miles) of roost sites in desert grasslands in New Mexico. A radio-tracking study in British Columbia found that foraging occurred within 1.5 kilometers (0.9 mile) of day roost sites (Rambaldini 2006). In this study, males returned to the day roost for short periods between foraging bouts (Rambaldini 2006) (however, note from discussion above that nightly foraging activity is seasonally variable). In coniferous forest in Northern California, radio-tracking documented that foraging bouts more than 2 kilometers (1.2 miles) from the day roost were common, but most foraging occurred in close proximity to day roosts (Baker et al. 2008). The longest distance moved during this study was 4.7 kilometers (2.9 miles) by a pregnant female. Lactating females had average foraging ranges of 1.56 square kilometers (0.6 square mile), and post-lactating females had average ranges of 5.97 square kilometers (2.3 square miles) (Baker et al. 2008). However, flights up to 30 kilometers (19 miles) between night roosts have been recorded, indicating that pallid bats have the capacity to fly long distances. Further, homing studies have shown a maximum return distance of 174 kilometers (108 miles), and several recoveries have shown return distances of 48 to 51 kilometers (30 to 32 miles) from release sites within 7 to 8 hours after release (Hermanson and O'Shea 1983).

Dispersal flights in the central Arizona study occurred in mid-August and were characterized by straight-line flight movements from the day roost (in contrast to the typical circling of the roost area) at approximately 25 meters (82 feet) above the ground and no evidence of foraging (O'Shea and Vaughan 1977). These dispersal flights occurred at the same time the population numbers at the day roost sharply declined (O'Shea and Vaughan 1977), indicating that young were leaving the maternity site.

Ecological Relationships

Day roost selection, fidelity, and lability (flexibility) by pallid bats indicate potentially important ecological relationships and are region-specific. As discussed in Habitat Requirements, pallid bats select day roosts that appear to maximize adaptive hypothermia (Vaughan and O'Shea 1976). In addition to microclimate stability, deep crevices used for day roosts may provide protection from predators and protection of juveniles that may fall from the ceiling (Lewis 1995). In central Arizona, where such deep crevices are available, females change day roosts in the spring, but not during pregnancy and lactation (O'Shea and Vaughan 1977). In Oregon, where such deep crevices are not available for roosting, females change day roosts throughout the summer (Lewis 1995). Lewis (1995) suggests that the Oregon populations benefit from roost lability by reducing ectoparasite infestations. In Arizona, the benefits of roost fidelity to the deep crevices may outweigh the impacts of ectoparasites (Lewis 1995).

In addition to selecting roosting sites to maximize adaptive hypothermia, social roosting also appears to be important for conserving metabolism. An experimental study showed that individual roosting bats had higher metabolic rates and weight loss than bats roosting in clusters and at suboptimal temperatures of 25 and 35 degrees Celsius (77 and 95 degrees Fahrenheit) (Trune and Slobodchikoff 1976).

Pallid bats may share both day and night roosts with other bat species such as Brazilian free-tailed bat (*Tadarida brasiliensis*) and Yuma myotis (*Myotis yumanensis*)(Hermanson and O'Shea 1983; Licht and Leitner 1967), but there is no evidence in the literature of competitive or symbiotic relationships with other bats. Congregations with other bat species at both day and night roosts may simply reflect use of limited resources.

Black (1974) suggested that bats may employ several types of foraging and food partitioning mechanisms that could reduce inter-specific competition, including size and type of prey; periods of activity (most bat prey are active within a few hours of sunset, but different prey have different peak activity periods); spatial partitioning, such as between-, within-, and below-canopy foragers; and flight patterns, such as slow vs. fast flying, maneuverability, and hovering.

Compared to other bat species, pallid bats emerge from day roosts relatively late in the evening (Hermanson and O'Shea 1983), but there is no information to suggest that this reflects competition for prey with other species. Artificial lighting may affect competitive predator-prey relationships among bats. Longcore and Rich (2004) suggest that artificial lighting, which attracts many insects taken by bats, including moths (Frank 1988), may alter local community relationships because the faster-flying bats congregate around lights and can exploit this concentrated food source while slower-flying bats avoid lights and are unable to benefit from this concentration of insects; however, whether this applies to pallid bats, which tend to concentrate their foraging near or on the ground, is unknown.

Colony sizes are variable, but maximum densities appear to be related to mid-summer densities of insect prey (Hermanson and O'Shea 1983). As discussed previously in Foraging Requirements, pallid bats often feed on ground insects, which may make them more vulnerable to injury and predation (Hermanson and O'Shea 1983).

Population Status and Trends

Global: Secure (NatureServe 2011)
State: Vulnerable (CDFW 2013)
Within Plan Area: Same as state

Pallid bat is a California Species of Special Concern, but little data is available to assess population status and trends. Ellison et al. (2003) compiled 292 observations for 133 colonies in 11 western states, including 35 (12%) from California. About 35% of the observations were from Arizona, 18% from Oregon, and 10% from New Mexico. However, most (78%) of the observations were collected before 1990. Information from only two sites was adequate to assess population trends: a bridge roost in Arizona that declined from 80 individuals to zero and a decline in a colony using crevices in cliffs in the Verde Valley of Arizona concurrent with increases in human activity in the area (Ellison et al. 2003). In California, Miner and Stokes (2005) noted a serious decline of pallid bats in the South Coast Ecoregion, especially in low-lying areas. They report that even as late as 1948 the species was considered to be abundant in buildings, but that by the 1970s only 1 of 12 known roost sites was still extant. Recent survey information for San Diego County indicates that few roosts that support bat species typically found in association with the pallid bat also include the species (Miner and Stokes 2005). Based on this apparent population decline, Miner and Stokes (2005) concluded that pallid bats are highly intolerant of urban development.

Threats and Environmental Stressors

As a colonial roosting species, pallid bats are particularly vulnerable to disturbances of roost sites through vandalism, extermination, and destruction of buildings used as roost sites (Hermanson and O'Shea 1983), as well as to recreational activities such as rock climbing. As noted previously, a decline in an Arizona colony occurred concurrent with an increase in human activity (Ellison et al. 2003). Miner and Stokes (2005) found that pallid bats have abandoned almost all previously occupied sites in the urbanized areas of the South Coast Region since the late 1940s. Beck and Rudd (1960) observed that female pallid bats are particularly sensitive to disturbance during the period prior to giving birth through weaning. A single disturbance may cause them to abandon the maternity roost prior to giving birth or to move to a more secluded part of the roost after giving birth (Beck and Rudd 1960).

Food availability may be reduced by pesticides or habitat modification or degradation such as conversion to agriculture, prescribed fires, and wildfires. Pesticides and heavy metals also may contaminate prey, causing secondary poisoning. Because this species often forages on the ground, it is susceptible to predation by urban-related predators (e.g., cats and possibly dogs) and potentially collection or harassment by humans.

Several recent studies have documented substantial mortality of bats at wind energy facilities (e.g., Baerwald and Barclay 2009; Cryan 2011; Cryan and Barclay 2009). While, as of 2010, there have been no reported fatalities of pallid bats at wind energy facilities (e.g., Tetra Tech EC Inc. 2010), Solick and Erickson (2009) indicate that there have been relatively few systematic, post-project, bat-fatality monitoring data collected for large, wind-energy projects in the arid southwestern United States. Although fatalities of this species at wind energy facilities have not been documented, it is expected that the species could be at risk from turbine strikes, or other factors associated with turbine operation, such as barotrauma, hypothesized to cause bat fatalities at wind facilities (Cryan and Barclay 2009). Pallid bats would be at greatest risk of turbine strikes or from other associated causes if a facility was located within a few miles of a day roost site (where most foraging activity occurs), and strikes would most likely occur during emergence and return to the day roost. Risk of strikes may also be higher during dispersal when young are leaving the natal roost site and fly in straight lines from the roost at altitudes of 80 feet or more (O'Shea and Vaughan 1977). Risk of strikes may be relatively low during foraging activities because pallid bats tend to forage on or close to the ground.

Conservation and Management Activities

Pallid bat is addressed in the West Mojave Plan (BLM 2005). Under Alternative A (the Proposed Action – Habitat Conservation Plan), BLM would implement several conservation measures for pallid bat, including:

- Protection of all significant roosts (defined as maternity and hibernation roosts supporting 10 or more individuals) by installing gates over mine entrances and restricting human access (The West Mojave Plan identified two significant maternity roosts and one significant maternity/hibernation roost for pallid bat on BLM-managed lands);
- Protection of bat roosts in the Pinto Mountains by gating known and new significant roosts and notifying claim holders on BLM lands containing significant roosts;
- Continued fencing around (but not over) open, abandoned mine features to provide bats access to roosts and to reduce hazards to the public;
- Required surveys for bats by applicants seeking discretionary permits for projects that would disturb natural caves, cliff faces, mine features, abandoned buildings, or bridges to determine whether significant roost sites are present; and
- Safe eviction of bats at a non-significant roost (i.e., fewer than 10 individuals) prior to disturbance or removal.

In addition, as a BLM sensitive species, pallid bat is addressed under land use actions undertaken by BLM. In accordance with BLM's "6840 – Special Status Species Management" manual, the objectives for sensitive species policy are:

> To initiate proactive conservation measures that reduce or eliminate threats to Bureau sensitive species to minimize the likelihood of and need for listing of these species under the ESA" (BLM 2008).

Under this policy, BLM must consider the impact of actions on sensitive species, including outcomes of actions (e.g., land use plans, permits), strategies, restoration opportunities, use restrictions, and management actions necessary to conserve BLM sensitive species.

Pallid bat is also addressed in the Military Integrated Resource Management Plans (INRMP) for the China Lake Naval Air Weapons Station (NAWS and BLM 2004) and the Marine Air Ground Task Force Training Command, Marine Corps Air Ground Combat Center, Twentynine Palms (MAGTFTC MCAGCC 2007). As a designated sensitive species in these INRMPs, pallid bat is provided protection and management considerations during the land use planning process defined in the China Lake Comprehensive Land Use Management Plan and military training operations at Twentynine Palms. If it is determined to be at risk from a proposed project or training activities, efforts are made to avoid and minimize impacts. For example, at Twentynine Palms, four bat gates have been installed in three mines to allow bats access to roosts without disturbance from humans. The Twentynine Palms INRMP also includes three objectives:

- Monitoring current bat gates to inspect for trespass and condition;
- Evaluating mine entrances for installation of bat gates to those mines that are exceptional bat habitat but not culturally significant; and
- Evaluating modification of bighorn sheep guzzlers for use by bats and other wildlife to enhance habitat value.

Data Characterization

There are relatively few data for pallid bat in the Plan Area. As noted in Distribution and Occurrences with the Plan Area, there are only 59 data records for the Plan Area, of which 39 are recent. Although this species is considered common in the Great Basin, Mojave, and Sonoran deserts, there is little information about roost sites, particularly winter roosting sites and hibernacula. There is also little information on seasonal movements.

Management and Monitoring Considerations

The primary management and monitoring consideration for the pallid bat is protection of day and night roosts from disturbance that may cause abandonment. This species requires very specific thermal conditions in day roosts (e.g., deep crevices that provide an optimum thermal environment), plus the additional factor that day roosts tend to be near water resources. These habitat requirements likely result in relatively few highly suitable day roosting sites in the Plan Area. Any occupied day roosts, therefore, should be considered a highly valuable resource, and impacts should be avoided. Maintaining these sites will require protecting them from human disturbances and adjacent land uses that could cause direct mortality or injury of pallid bats or abandonment of the roost site.

Species Modeled Habitat Distribution

This section provides the results of habitat modeling for pallid bat, using available spatial information and occurrence information, as appropriate. For this reason, the term "modeled suitable habitat" is used in this section to distinguish modeled habitat from the habitat information provided in Habitat Requirements, which may include additional habitat and/or microhabitat factors that are important for species occupation, but for which information is not available for habitat modeling.

There are 19,196,457 acres of modeled suitable habitat for pallid bat in the Plan Area. Appendix C includes a figure showing the modeled suitable habitat in the Plan Area.

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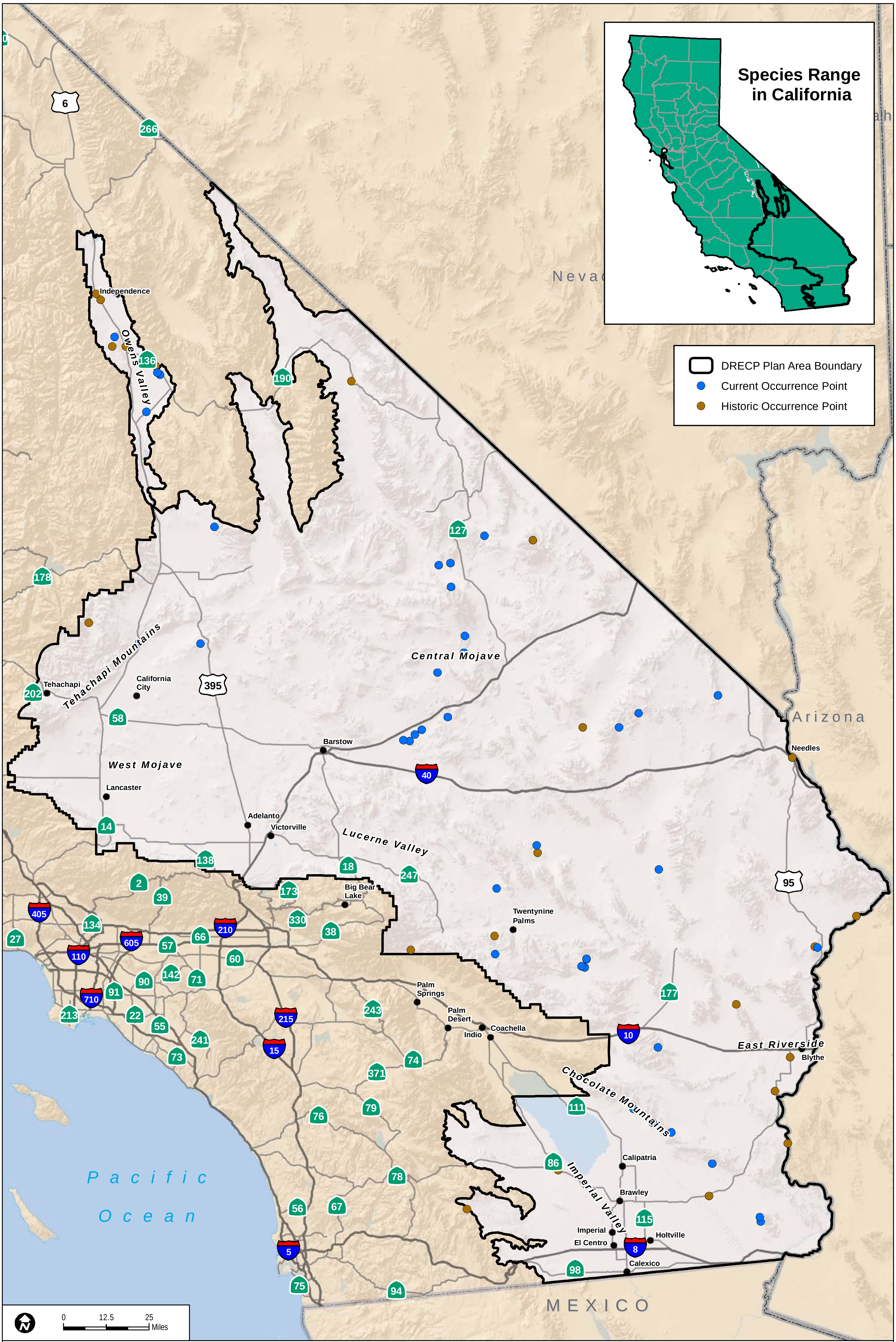

Sources: ESRI (2014); DRECP Species Occurrence Database (2013), CWHR (2008)

FIGURE SP-M06

Pallid Bat Occurrences in the Plan Area